Mars Hill Windfarm Post-Development Fourth-Quarter Sound Level Study Peer Review

MARS HILL, MAINE

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Review Basis

UPC Wind Management LLC/Evergreen Wind Power LLC (UPC) operates a 28 unit wind facility along the ridge line of Mars Hill in Mars Hill, Maine. At the request of the Maine Department of Environmental Protection (MEDEP) this continuing peer review is undertaken to provide expert opinion as to:

> "Whether post-development reporting is reasonable and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10) and
>
> Whether the report provides a reasonable basis upon which to determine compliance or non-compliance with the operational noise limits set forth in the Control of Noise rules and the variance given in Department Order L-21635-26-A-N/L-21365-TG-B-N, dated June 1, 2004."

The post-development ambient and operational noise studies were completed by Resource Systems Engineering (RSE)[1] in December 2006 (ambient), May 2007 (ambient and operation), September 2007 (operation), January 2008 (operation) and May 2008 (ambient and operation). Each section of the September 5, 2008 report will be generally critiqued unless detailed criticism is given.

1.0 Introduction

The stated objective of this sound level study is to compare wind farm operation sound levels with predicted estimates and evaluation of the ambient sound levels in the vicinity of the wind farm.

The Resource Systems Engineering (RSE) reports of June 21, 2007, November 2, 2007 and April 11, 2008 are referenced for additional details concerning previous portions of the sound level study.

2.0 Sound and Decibels

Informational

3.0 Site Description

Referenced to RSE report June 21, 2007.

4.0 MDEP Standards

Referenced to RSE report June 21, 2007.

[1] *Sound Level Study & Operational Sound Level Monitoring Maine Department Of Environmental Protection Order No.L-21635-26-AN*, Resource Systems Engineering

5.0 Sound Level Model Estimates for Wind Farm Operation

Referenced to RSE report June 21, 2007.

6.0 Ambient Sound Levels

Referenced to RSE reports June 21, 2007 and April 11, 2008. Fourth-quarter measurement protocol included periodic shutdowns of the wind farm operations. The purpose of the shutdowns was to enable direct measurement of ambient sounds for brief periods.

7.0 Operating Sound Levels

Operations sound measurements began the evening of May 27, 2008 and continued through the evening of May 29, 2008 for an approximate total of 46 hours. Measurements were made under varying wind and operating conditions including periodic shutdowns in order to determine sound levels at community monitoring positions attributable to routine operation of the wind farm. Measured ambient sound levels (shutdown) were subtracted from overall sound levels to determine the sound level contribution of the wind turbines. Wind turbine operations sound levels were compared to the ambient and predicted sound levels, as provided to the MEDEP as part of the site permit application.

7.1 Measurement Procedures

The stated primary objective was to measure wind farm sound levels at nearby protected locations during conditions when the sound from the wind farm is most noticeable.

A single 7 inch diameter foam windscreen was rotated between instruments and at site MP-1A. The large diameter and a standard size windscreen performances are compared in section 7.2 .2. Windscreen wind speed performance was not directly assessed, but rather previously provided by reference[2] through e-mail.

Monitoring site relocations were reasonable and consistent with objectives. Site MP-1A provided one of two sites to measure surface wind without nearby obstruction and to measure operation sound levels away from the hedgerow proximal to the site MP-1. Wind data was measured at a height of 8 to 10 feet above grade and concurrently on windmill towers.

7.1.2 Ambient Shutdown Testing

Ambient level testing at sensitive monitoring positions was completed during respective turbine shutdowns and confirmed by field observation. Individual turbines were shut

[2] Jakobsen, Jorgen, "Investigation of Windscreen Insertion Loss and Attenuation of Wind Noise", DELTA Acoustics & Vibration: Note 1,JOR3-CT95-0065. January 1997.

down sequentially with completed shutdown durations of approximately 15 minutes to facilitate measurement of ambient sound levels at all 4th-quarter community positions, except MP-5. Turbine restarts occurred sequentially approximately every 30 seconds.

Reported sound levels were calculated from 5-second time history data. An exception occurred at MP-7A, where sound levels were reported for five-minute intervals.

7.2.1 Ambient Sound Levels

Figure 7-3. Sample Sound Level Measurements For Wind Turbine Shutdowns represents a shutdown period for May 28, 2008, 23:50 hrs through May 29, 2008, 0:07 hrs where average 1-minute wind speeds seem well within the 12 mph measurement criteria. Wind conditions for the same time period in Appendix VII indicate maximum wind speeds at both MP-1A & MP-2 approaching 20 mph.

The masked effect of averaging one minute anemometer readings during gusty conditions ≥12 mph underestimates significant acoustic effects (foliage or microphone interference) producing disproportionate skewing of sound levels. The resultant sound reading increase is disproportionately large (non-linear) as compared to the arithmetic wind speed average. Measurement position MP-1 was especially sensitive to this phenomena due to the close by hedgerow of trees.

The point made in the first paragraph on 4Q report page 14 regarding the L_{50}/L_{EQ} is useful in the presence of a skilled observer using additional measurement parameters, i.e. wind speed and wind speed variation, but is position and wind condition specific. Under conditions when the L_{EQ} and L_{50} differ there is not sufficient information to conclude that the L_{50} correlates significantly better for the contribution from wind turbines.

7.3 Adjustment to Sound Levels Based on Data from Ambient Shutdowns

Table 7-6 Operating Sound Levels and Ambient Adjustments for Position MP-8 indicates adjusted operating sound levels ranging from 45 - 52 dBA. Of the 20 hours of adjusted L_{Aeq} values listed, 7 exceed 50 dBA.

8.0 Findings and Recommendations

RSE concludes that four quarters ambient/operation sound level testing has been representative of expected operating conditions and has yielded consistent results confirming a refined and reliable testing method for determining sound levels from windmill turban operations.

Operation sound level testing has been representative of expected operating conditions and has been sufficiently consistent for least impacted locations. In instances where operation levels have approached or exceeded regulatory limits, testing methodologies have not been sufficiently refined to clearly isolate operations from ambient sound levels.

Conclusion - (Peer Review)

The ambient sound level monitoring during 4Q turbine shutdowns provides a very brief (< 2 hrs. cumulative), and broad representation of ambient sound levels during wind conditions required for operation.

Operation sound levels calculated using ambient measurements selected from 4Q shutdown periods were conservative and credible.

The L_{A50} may be a reliable indicator of the hourly equivalent sound level (L_{Aeq}) from operation of wind turbines during a relatively stable atmosphere, when surface winds are light and the L_{Aeq} and L_{A50} are in close agreement. Sufficient wind/operation data has not been reliably correlated with the L_{A50} to support its superiority over the L_{Aeq} for assessment of wind turbine operation sound levels.

It is the opinion of the reviewer that this 4th assessment of the project demonstrates compliance at nearly all bordering protected locations, except the protected location adjacent MP-8, as established in the Control of Noise rules and the variance given in Department Order L-21635-26-A-N/L-21365-TG-B-N, dated June 1, 2004.

The study is reasonable, and technically correct according to standard engineering practices and the Department Regulations on Control of Noise (06-096 CMR 375.10).

In instances where operation levels approach or exceed regulatory limits testing methodologies have not been sufficiently refined to adequately isolate operation sound levels. The resulting gray region (compliance/noncompliance) can only be adequately addressed by tightening measurement system methodologies. The following specifications form a protocol for addressing this issue. These recommendations are intended to add clarification and specificity to existing section 10 requirements, as they pertain to wind turbine noise assessment.

Most consistent and prominent wind turbine operation sound levels occur during periods when unobstructed surface winds are light (≤12 mph, inclusive of wind gusts) and hub wind speeds are adequate for maximum sound production operation. Measurements should be assessed over a sufficient period to accumulate a total of 48 hours of data meeting this criteria.

Meteorological measurements should be generally position specific (but not necessarily in immediate proximity), unobstructed (where possible) and most importantly reporting average/maximum speed per unit time, representative of all wind directions.

Sound monitoring devices should be positioned to most closely reflect each protected location (especially the residence), avoiding non-representative, localized potential noise sources.

Longer-term sound monitoring results should be reported for periods where maximum surface wind speeds are ≤12 mph and displayed together with maximum and actual predictive model sound levels based on manufacturers specification, less attenuating factors.

Parameters to be reported should include, by site; specific acoustic factors—maximum/actual predictive levels, hourly L_{Aeq}/ L_{A50}, etc. and average hourly wind speed/maximum in mph. Representative area NOAA meteorological wind data inclusion is strongly suggested.